



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Sophie Wilson

Appl. No.: 09/395,294

Filed: September 13, 1999

For: **An Instruction Set for a Computer**

Confirmation No. 5796

Art Unit: 2183

Examiner: T. Meonske

Atty. Docket: 1875.5790000

Brief On Appeal Under 37 C.F.R. § 41.37

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

A Notice of Appeal from the final rejection of claims 17-33 for the above-captioned U.S. patent application was filed on January 19, 2005, together with the required fee of \$500 under 37 C.F.R. § 41.20(b)(1) for a large entity. Appellant hereby files this Appeal Brief, together with the required fee of \$500.00 under 37 C.F.R. § 41.20(b)(2) for a large entity.

The Commissioner is hereby authorized to charge any fee deficiency, or credit any overpayment, to our Deposit Account No. 19-0036.



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I. Real Party in Interest (37 C.F.R. § 41.37(c)(1)(i))

The real party in interest in this appeal is Broadcom Corporation, having its principal place of business at 16215 Alton Parkway, Irvine, California 92618. An assignment assigning all right, title and interest in and to the above-captioned patent application from inventor Sophie Wilson to Broadcom Corporation was recorded in the U.S. Patent & Trademark Office (USPTO) on June 9, 2000 at Reel 010873, Frame 0652.

II. Related Appeals and Interferences (37 C.F.R. § 41.37(c)(1)(ii))

Appellant, including the undersigned legal representative and the assignee of the above-captioned application, are aware of no pending appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board of Patent Appeals and Interferences ("the Board") in the pending appeal.

III. Status of the Claims (37 C.F.R. § 41.37(c)(1)(iii))

This application was filed on September 13, 1999 and assigned U.S. Application No. 09/395,294 ("the '294 application"). The '294 application included claims 1-16. In an Amendment and Response to Office Action filed April 15, 2002, claim 13 was cancelled, and claims 12 and 14 were amended. In an Amendment and Response to Office Action filed December 20, 2002, claims 3, 12, and 15 were amended. In an Amendment and Response to Office Action filed July 3, 2003, claims 2 and 3 were cancelled, and claims 1, 12, and 14-16 were amended. In an Amendment and Reply Under 37 C.F.R. § 1.116 filed March 24, 2004, claims 1, 4-12,

and 14-16 were cancelled, and new claims 17-33 were added. As such, claims 17-33 are currently pending in the present application.

In an Amendment and Reply Under 37 C.F.R. § 1.111 filed July 16, 2004, claims 17, 24, 28, 32, and 33 were amended

A Final Rejection rejecting claims 17-33 was mailed on October 19, 2004 (the "Final Rejection"). The Final Rejection incorporated by reference the several grounds of rejection set forth in the Office Action mailed April 16, 2004 (the "Office Action"). A Notice of Appeal was filed on January 19, 2005. Claims 17-33 are on appeal. A copy of the claims on appeal can be found in the attached Claims Appendix.

IV. Status of Amendments (37 C.F.R. § 41.37(c)(1)(iv))

No amendments have been filed by Appellant subsequent to the Examiner's Final Rejection.

V. Summary of the Claimed Subject Matter (37 C.F.R. § 41.37(c)(1)(v))

The present invention is directed to an instruction set for a computer.

A very long instruction word (VLIW) is a type of instruction set that includes multiple instructions that may be executed simultaneously. Each instruction of the VLIW has the same bit length, meaning that each instruction includes the same number of bits. The VLIW has a first bit length, and each instruction of the VLIW has a second bit length. For example, if the VLIW includes four instructions, the second bit length is one-fourth of the first bit length.

The VLIW arrangement avoids misalignment problems associated with some other types of instruction set arrangements, which allow instructions to be of different lengths. However, the length of each instruction of the VLIW, and therefore the potential complexity of respective instructions, is limited.

The present invention solves this problem by allowing an instruction of the VLIW to define a single operation or multiple independent operations.

In the present invention, a decode unit decodes an instruction of a VLIW received during an instruction fetch. The decode unit is operable to determine whether the instruction of the VLIW defines a single operation or multiple independent operations. The decode unit is further operable to control multiple processing channels based on the determination. If the instruction defines a single operation, the decode unit controls the processing channels to cooperate to execute the single operation. If the instruction defines multiple independent operations, the decode unit controls a first processing channel to implement a first operation of the multiple independent operations and a second processing channel to implement a second operation of the multiple independent operations.

An instruction of a VLIW can be a long instruction defining a single operation, or a dual operation instruction defining two independent operations. Each instruction of the VLIW may include identification bits at designated bit locations in the instruction. The identification bits have a dual purpose: denoting whether the instruction is a long instruction or a dual operation instruction and identifying the type of operations in a dual operation instruction.

VI. Grounds of Rejection to be Reviewed (37 C.F.R. § 41.37(c)(1)(vi))

The grounds of rejection to be reviewed on appeal are:

- A. whether claims 17-20, 24, and 25 are patentable under 35 U.S.C. § 102(b) over U.S. Patent No. 6,317,820 to Shiell et al. ("Shiell"), attached hereto as Exhibit A;
- B. whether claims 21-23, 26, 27, and 32 are patentable under 35 U.S.C. § 103(a) over Shiell in view of U.S. Patent No. 5,761,470 to Yoshida ("Yoshida"), attached hereto as Exhibit B;
- C. whether claim 28 is patentable under 35 U.S.C. § 103(a) over Shiell in view of U.S. Patent No. 6,697,774 to Panesar ("Panesar"), attached hereto as Exhibit C; and
- D. whether claims 29-31 and 33 are patentable under 35 U.S.C. § 103(a) over Shiell in view of Yoshida and Panesar.

VII. Argument (37 C.F.R. § 41.37(c)(1)(vii))

In the remarks that follow, the rejection of each claim is separately discussed. Appellant recognizes that any claim that depends from a patentable independent claim is patentable at least by virtue of its dependency. In addition, claims 18-23, which depend from claim 17, claims 25-27, which depend from claim 24, and claims 29-31, which depend from claim 28, are patentable not only in view of their dependencies, but also by virtue of their specifically recited features.

A. Rejections under 35 U.S.C. § 102(b)

The Examiner rejected claims 17-20, 24, and 25 under 35 U.S.C. § 102(b) as being allegedly anticipated by Shiell. Appellant respectfully traverses this rejection. The patentability of each of the above-referenced claims is separately discussed below.

Claim 17

Claim 17 recites, among other features,

a decode unit to decode *an instruction of a VLIW* received during an instruction fetch, ... wherein the decode unit is operable to determine whether *the instruction defines a single operation or two independent operations* and to control the first and second processing channels based on the determination.

VLIW is an abbreviation for "very long instruction word", which is a term of art. A VLIW is a type of instruction set that includes multiple instructions, which may be executed in parallel on different functional units of a processor. Claim 17 calls for a decode unit that is operable to determine whether an instruction of a VLIW defines a single operation or two independent operations.

In the Final Rejection, the Examiner stated:

Shiell et al. have in fact taught an instruction of a VLIW (abstract, column 3, lines 50-67, The processor is a VLIW that processes VLIW instructions.) received during an instruction fetch (column 4, lines 1-5) can define a single operation or two independent operations (column 2, lines 52-56, The VLIW instructions can change the processor from the first mode (the execution of a single operation), or the second mode (the execution of two independent operations)).

Final Rejection, dated October 19, 2004, at p. 3.

Appellant respectfully submits that the Examiner has misunderstood Shiell's teachings. The system in Shiell is described with respect to a Texas Instruments

TMS320C62x/C67x ("C6x") family of processors. Shiell describes a C6x processor, as illustrated in FIG. 1 of Shiell, as follows:

[T]his type of processor uses multiple instructions grouped together. Under software control (normally the compiler) instructions are grouped into blocks of 8 as a single VLIW. These blocks of 8 instructions are dispatched to the multiple functional units of the VLIW pipeline. A single VLIW in C6x terminology is referred to as an Instruction Packet.... [An] Instruction Dispatch/Decode unit 115 decodes these component instructions, schedules them and lastly dispatches them to the specific function unit (S, L, M or D) and sides as indicated by the instruction.

Shiell, Col. 3, line 62 - Col. 4, line 8.

The system in Shiell is described with respect to FIG. 2 as follows:

Fetch program counter and control units 110A and 110B *each fetch a half packet of instructions, (1/2 of a VLIW eight instruction packet)* from program memory 105 (which is now dual ported), into respective Instruction Dispatch/Decode units 115A and 115B.... Then each side's dispatch and decode logic 115A and 115B prepares the half packets for execution as per a "normal" C6x. After which the instructions are dispatched to their respective sides (instructions on A side to the A functional units S1, L1, M1 and D1, and B instructions to the B units S2, L2, M2 and D2). From dispatch on the processor acts as a "normal" C6x except for the handing of changes in control flow such as interrupts and branches.[sic]

Shiell, Col. 4, line 67 - Col. 5, line 13 (*emphasis added*).

For further illustration, Shiell states:

The following is an example of how a C6x system modified according to this invention converts from running a single thread in single PC mode, as in FIG. 1, to running dual threads in dual PC mode, as in FIG. 2....

Shiell, Col. 6, lines 19-22.

Figures 1 and 2 are provided below to better illustrate the differences between the present invention and the teachings of Shiell. Figure 1 is an example illustration of the present invention. In Figure 1, a VLIW includes multiple instructions (i.e.,

Instructions 1 and 2). Instruction 1 includes multiple operations (i.e., Operations 1 and 2), and Instruction 2 includes a single operation (i.e., Operation 3). As shown in Figure 1, an instruction of the VLIW may include a single operation or multiple operations.

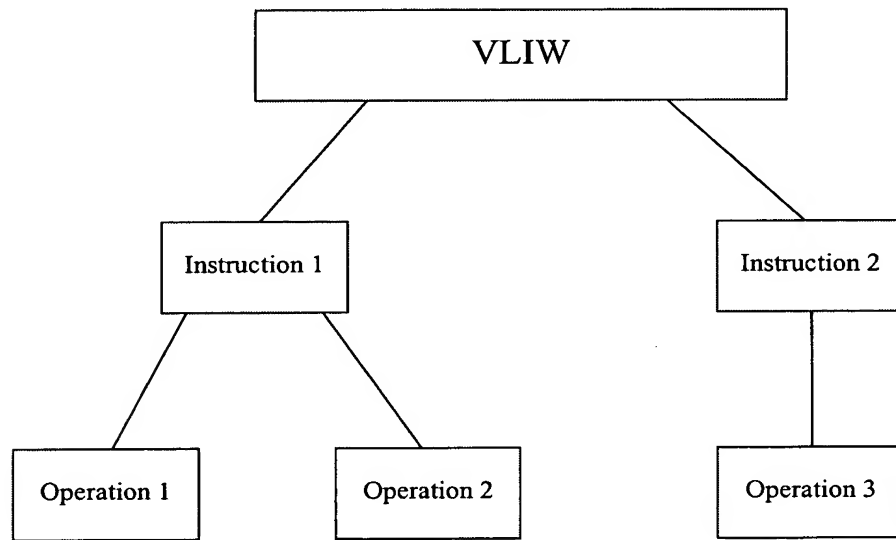


Figure 1

Shiell describes processing a VLIW using a single PC mode and alternatively using a dual PC mode. The single PC mode is described as conventional processing of a VLIW as known in the art. For example, the VLIW is processed as a single stream of instructions. Figure 2 illustrates the dual PC mode described in Shiell. As shown in Figure 2, a VLIW of eight instructions is separated into two half-packets, which are also referred to as streams. Each half-packet/stream includes four instructions. The half-packets may be processed on respective sides of a data processor. Alternatively, instructions may be processed alternately from the half-

packets. The processor in Shiell is not described as allowing an instruction of the VLIW to define two independent operations.

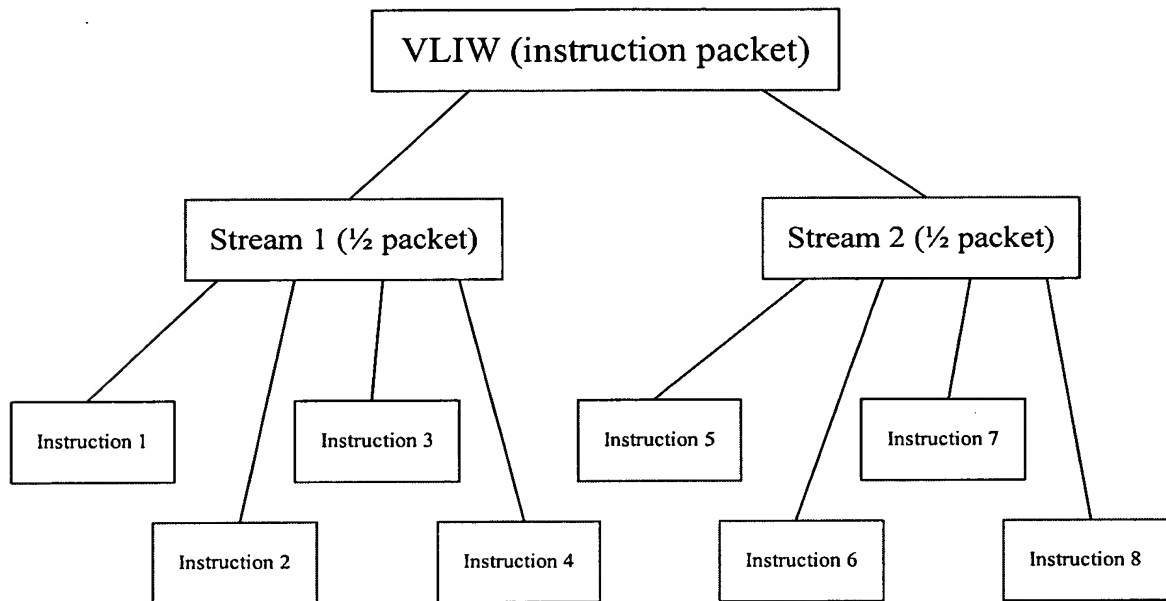


Figure 2

The Examiner contends that Shiell teaches a processor that performs two independent operations. However, the alleged "two independent operations" to which the Examiner refers are each merely a half-packet of instructions (1/2 of a VLIW eight instruction packet). Thus, each of the "two independent operations" is merely a group of four instructions of the VLIW.

Therefore, Shiell does not teach or suggest a decode unit that is operable to determine whether an instruction of a VLIW defines a single operation or two independent operations, as set forth in independent claim 17. Accordingly, claim 17

is patentable over Shiell for at least the reason that Shiell does not teach each and every feature of claim 17.

Claim 18

Claim 18 recites, among other features,

when the decode unit determines that the instruction defines two independent operations....

In Shiell, a half-packet of instructions is fetched into each of the Instruction Dispatch/Decode units 115A and 115B. "Instruction Adapter units 217A and 217B bind the instructions to the A and B sides respectively. Then each side's dispatch and decode logic 115A and 115B prepares the half packets for execution as per a 'normal' C6x" (Shiell, Col. 4, line 67 - Col. 5, line 8). Thus, Decode units 115 operate the same, regardless whether the VLIW is processed using a single PC mode or a dual PC mode. Nothing in Shiell even suggests that the decode unit determines that the instruction defines two independent operations, as set forth in claim 18. Accordingly, claim 18 is patentable over Shiell for at least the reason that Shiell does not teach each and every feature of claim 18.

Claim 19

Claim 19 recites, among other features,

when the decode unit determines that the instruction defines a single operation....

In Shiell, Decode units 115 operate the same, regardless whether the VLIW is processed using a single PC mode or a dual PC mode. Nothing in Shiell even suggests that the decode unit determines that the instruction defines a single

operation, as set forth in claim 19. Accordingly, claim 19 is patentable over Shiell for at least the reason that Shiell does not teach each and every feature of claim 19.

Claim 20

Claim 20 recites, among other features,

the first and second processing channels share at least one common register file and are capable of simultaneously accessing the at least one common register file.

Shiell merely states that "each instruction on A side 130A or B side 130B has its register arguments read from the associated register file 140A or 140B. In addition, one cross register read is allowed per side via register cross path 145." (Shiell, Col. 4, lines 25-28). Nothing in Shiell even suggests that the first and second processing channels share at least one common register file and are capable of simultaneously accessing the at least one common register file, as set forth in claim 20. Accordingly, claim 20 is patentable over Shiell for at least the reason that Shiell does not teach each and every feature of claim 20.

Claim 24

Claim 24 recites, among other features,

decoding an instruction of the VLIW ... to determine whether the instruction defines a single operation or two independent operations;
when the instruction defines two independent operations....

As described above and further illustrated in Figure 2, Shiell does not teach or suggest decoding an instruction of the VLIW to determine whether the instruction defines a single operation or two independent operations, as set forth in Appellant's claim 24. Moreover, Shiell does not even suggest that the instruction defines two independent operations, as set forth in Appellant's claim 24. Accordingly, claim 24 is

patentable over Shiell for at least the reason that Shiell does not teach each and every feature of claim 24.

Claim 25

Claim 25 recites, among other features,

determining whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction.

The Office Action merely stated that "claim 25 has nothing over claim 21 and is therefore rejected for the same reasons as set forth in claim 21." However, claim 21 was rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Shiell in view of Yoshida. The Appellant asserts that the rejection of claim 25 under 35 U.S.C. § 102(b) is improper because the rejection is based on a combination of references.

Moreover, at paragraph 11 of the Office Action, the Examiner conceded that "Shiell et al. have not specifically taught wherein the decode unit is operable to determine whether the instruction defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction."

Referring to the rejection of claim 21, the Examiner relied on Figure 25 and elements 505 and 506 of Yoshida to allegedly show the teachings missing from Shiell. However, Figure 25 of Yoshida merely shows a VLIW format in which one or two 1-bit format fields are used and one VLIW includes one or two instructions. The confusion appears to be a matter of semantics.

In the present patent application, a VLIW is referred to as a VLIW, and the instructions in the VLIW are referred to as VLIW instructions. For example, the Background to the Invention section of the present patent application provides:

... a number of instructions are retrieved from memory in each instruction fetch, each instruction fetch having a certain bit length and each individual instruction (slot) having a certain bit length (so-called VLIW instructions).

However, it appears that in Yoshida, a VLIW is referred to as a VLIW instruction, and the instructions that are included in the VLIW are referred to as operations. For example, Yoshida explains in the Background of the Invention section:

The present invention relates to a data processor for performing a plurality of operations in parallel at a high efficiency by executing a so-called VLIW ... type instruction which specifies a plurality of operations by one instruction.

Yoshida, Col. 1, lines 9-15. Yoshida further explains:

[T]he VLIW technique is a parallel operation technique in which *one instruction consists of a plurality of parallel executable operations....* A plurality of operations which are specified by this long instruction word are executed in parallel. *These types of conventional data processors ... guarantee[] that instructions have the same length and all of a plurality of operations which are described within one instruction can be executed in parallel....*

Yoshida, Col. 1, lines 25-48 (emphasis added).

In a conventional VLIW processor, VLIWs have the same length and all of the instructions in the VLIW can be executed in parallel. VLIWs (i.e. "instructions" as described by Yoshida) are retrieved from memory in each instruction fetch. Moreover, in a conventional VLIW processor, instructions are not capable of defining two independent operations. The instructions and operations described by Yoshida

correspond to the VLIWs and instructions, respectively, described in the present patent application.

Yoshida does not supply the teachings missing from Shiell. Therefore, Shiell and Yoshida, considered alone or in combination, do not teach or suggest determining whether the instruction defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction, as set forth in Appellant's claim 25. Accordingly, claim 25 is patentable over Shiell and Yoshida, considered alone or in any rational combination.

B. Rejections under 35 U.S.C. § 103(a)

Claims 21-23, 26, 27, and 32

The Examiner rejected claims 21-23, 26, 27, and 32 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Shiell in view of Yoshida. Appellant respectfully traverses this rejection. The patentability of each of the above-referenced claims is separately discussed below.

Claim 21 recites, among other features,

*the decode unit is operable to **determine whether the instruction defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction.***

The Final Rejection incorporated by reference the several grounds of rejection set forth in the Office Action. At paragraph 11 of the Office Action, the Examiner conceded that "Shiell et al. have not specifically taught wherein the decode unit is operable to determine whether the instruction defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction." The Examiner relied on Figure 25 and

elements 505 and 506 of Yoshida to allegedly show the teachings missing from Shiell. However, Figure 25 of Yoshida merely shows a VLIW format in which one or two 1-bit format fields are used and one VLIW includes one or two instructions. In Yoshida, each 1-bit format field corresponds to a respective instruction. For example, in Figure 25 of Yoshida, VLIW 501 includes format fields 505 and 506 corresponding to respective instructions 511 and 512, and VLIW 502 includes format field 505 corresponding to instruction 513. As shown in Figure 25 of Yoshida, a VLIW that includes one format field includes one instruction, and a VLIW that includes two format fields includes two instructions. Nothing in Yoshida even suggests that a decode unit is operable to determine whether an instruction of a VLIW defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction, as set forth in Appellant's claim 21. Thus, Yoshida fails to supply the teachings missing from Shiell.

Therefore, Shiell and Yoshida, considered alone or in any rational combination, do not teach or suggest that a decode unit is operable to determine whether an instruction of a VLIW defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction, as set forth in Appellant's claim 21. Accordingly, claim 21 is patentable over Shiell and Yoshida, considered alone or in combination.

Claim 22 recites, among other features,

the instruction has a length of n bits, and *the at least one predetermined bit location includes the $n/2$ th bit and the n th bit.*

The Examiner relies on elements 505 and 506 in Figure 25 of Yoshida to allegedly teach the n th and $n/2$ th bits, respectively, of the instruction in Appellant's claim 22. However, upon closer inspection, elements 505 and 506 are not at predetermined bit locations *in an instruction* of the VLIW. Instead, element 505 corresponds to instruction 511 of VLIW 501, and element 506 corresponds to instruction 512 of VLIW 501. Elements 505 and 506 do not correspond to the n th and $n/2$ th bits, respectively, of an instruction (or even the VLIW 501). Bits of the VLIW 501 are clearly numbered from 0 to 31, such that $n=32$. Because the bits of the VLIW are numbered from 0 to 31, the bit labeled "0" is the first bit of the VLIW, the bit labeled "1" is the second bit, and so on. Thus, element 505 in Figure 25 corresponds to the first bit of VLIW 501, and element 506 corresponds to the seventeenth, $(n/2+1)$ th, bit of the VLIW 501.

Shiell and Yoshida, considered alone or in combination, do not teach or suggest that the at least one predetermined bit location includes the $n/2$ th bit and the n th bit, as set forth in Appellant's claim 22. Therefore, the Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 22 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 22. Accordingly, the rejection of claim 22 under 35 U.S.C. § 103(a) is improper and should be reversed.



Claim 23 recites, among other features,

the decode unit is operable to identify certain combinations of the two independent operations based on the at least one identification bit, and wherein a first combination denotes two data processing operations, a second combination denotes two memory access operations, a third combination denotes a data processing operation and a memory access operation, and a fourth combination denotes a long instruction.

The Examiner relies on Col. 2, lines 23-56 and Col. 3, line 50 - Col. 4, line 9 of Shiell to allegedly teach the feature of claim 23 recited above. However, the Examiner merely states that the first three combinations are identified when an instruction from side A and an instruction from side B are dispatched to certain of the S, L, M, or D functional units, and the fourth combination denotes a long instruction. Nothing in the cited material or in Yoshida even suggests a decode unit that is operable to identify certain combinations of the two independent operations [of an instruction of a VLIW] ***based on the at least one identification bit*** [at at least one predetermined location in the instruction], as set forth in Appellant's claim 23.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 23 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 23. Accordingly, the rejection of claim 23 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 26 recites, among other features,

determining whether the instruction defines the single operation or the two independent operations based on the at least one identification bit that indicates the nature of the two independent operations when the instruction defines the two independent operations.

At paragraph 14 of the Office Action, the Examiner merely stated that "claim 26 has nothing over claim 21 and is therefore rejected for the same reasons as set forth in claim 21." It is Appellant's position that claim 26 is patentable over Shiell and Yoshida, considered alone or in combination, for at least the same reasons as those set forth above with respect to claim 21. Moreover, nothing in the combination of Shiell and Yoshida teaches or suggests determining whether the instruction defines the single operation or the two independent operations based on the at least one identification bit that indicates the nature of the two independent operations when the instruction defines the two independent operations, as set forth in Appellant's claim 26.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 26 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 26. Accordingly, the rejection of claim 26 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 27 recites, among other features,

determining whether the instruction defines the single operation or the two independent operations is based on an $n/2$ th bit and an n th bit of the instruction having n bits.

At paragraph 15 of the Office Action, the Examiner merely stated that "claim 27 has nothing over claim 6 and are [sic] therefore rejected for the same reasons as set forth in claim 6." Claim 6 is cancelled. Nevertheless, Shiell or Yoshida, considered alone or in combination, do not teach or suggest that determining whether the instruction defines the single operation or the two independent operations is based on an $n/2$ th bit and an n th bit of the instruction having n bits, as set forth in Appellant's

claim 27. For example, in Figure 25 of Yoshida, elements 505 and 506 do not correspond to the n th and $n/2$ th bits, respectively, of an instruction (or even the VLIW 501). Instead, element 505 in Figure 25 corresponds to the first bit of VLIW 501, and element 506 corresponds to the seventeenth, $(n/2+1)$ th, bit of the VLIW 501.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 27 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 27. Accordingly, the rejection of claim 27 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 32 recites, among other features,

decoding each instruction of the VLIW, wherein decoding each instruction includes ***reading the identification bit of each instruction to determine ... whether the instruction defines a single operation or two independent operations...***

In paragraph 12 of the Final Rejection, the Examiner conceded that Shiell fails to teach decoding that includes reading the identification bit of each instruction to determine whether the instruction defines a single operation or two independent operations. The Examiner relied on Figure 25 and elements 505 and 506 of Yoshida to allegedly show the missing teachings. However, Figure 25 of Yoshida merely shows a VLIW format in which one or two 1-bit format fields are used and one VLIW includes one or two instructions. Shiell and Yoshida, considered alone or in combination, do not teach or suggest reading the identification bit of each instruction to determine whether the instruction defines a single operation or two independent operations, as set forth in Appellant's claim 32.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 32 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 32. Accordingly, the rejection of claim 32 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 28

The Examiner rejected claim 28 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Shiell in view of Panesar. Appellant respectfully traverses this rejection.

Claim 28 recites, among other features,

...commands to enable the processor-based system to ***decode an instruction of the VLIW*** received during an instruction fetch ***to determine whether the instruction defines a single operation or two independent operations...***

Appellant asserts that Shiell does not teach or suggest *commands to enable the processor-based system to decode an instruction of the VLIW ... to determine whether the instruction defines a single operation or two independent operations*, as set forth in Appellant's claim 28.

Appellant further asserts that Panesar has nothing to do with determining whether an instruction of a VLIW defines a single operation or two independent operations.

In paragraph 13 of the Final Rejection, the Examiner stated:

[T]he fact that Panesar may have nothing to do with "determining whether an instruction of a VLIW defines a single operation or two independent operations" is irrelevant because Panesar has been cited for teaching the simulation of a processor with commands such as VHDL (Panesar, column 8, lines 25-36).

Final Rejection, dated October 19, 2004, at p. 5.

Nevertheless, Panesar does not supply the teachings missing from Shiell. Thus, Shiell and Panesar, considered alone or in combination, do not teach or suggest *commands to enable the processor-based system to decode an instruction of the VLIW ... to determine whether the instruction defines a single operation or two independent operations*, as set forth in Appellant's claim 28.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 28 for at least the reason that the cited references do not teach each and every feature of claim 28. Accordingly, the rejection of claim 28 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claims 29-31 and 33

The Examiner rejected claims 29-31 and 33 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Shiell in view of Yoshida and Panesar. Appellant respectfully traverses this rejection. The patentability of each of the above-referenced claims is separately discussed below.

Claim 29 recites, among other features,

...commands to enable the processor-based system to **decode the instruction** [of the VLIW] **to determine whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction.**

In the Office Action, the Examiner conceded that the combination of Shiell and Panesar does not teach commands to enable the processor-based system to decode the instruction [of the VLIW] to determine whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction. The Examiner relied on

elements 505 and 506 in Figure 25 of Yoshida to allegedly show the teachings missing from Shiell and Panesar. However, Figure 25 of Yoshida merely shows a VLIW format in which one or two 1-bit format fields are used and one VLIW includes one or two instructions. In Yoshida, each 1-bit format field corresponds to a respective instruction. For example, in Figure 25 of Yoshida, VLIW 501 includes format fields 505 and 506 corresponding to respective instructions 511 and 512, and VLIW 502 includes format field 505 corresponding to instruction 513. As shown Figure 25 of Yoshida, a VLIW that includes one format field includes one instruction, and a VLIW that includes two format fields includes two instructions. Nothing in Yoshida even suggests commands to enable the processor-based system to decode the instruction [of the VLIW] to determine whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction, as set forth in Appellant's claim 29. Thus, Yoshida fails to supply the teachings missing from Shiell and Panesar.

Therefore, Shiell, Yoshida, and Panesar, considered alone or in any rational combination, do not teach or suggest commands to enable the processor-based system to decode the instruction [of the VLIW] to determine whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction, as set forth in Appellant's claim 29. Accordingly, claim 29 is patentable over Shiell, Yoshida, and Panesar, considered alone or in combination.

Claim 30 recites, among other features,

...commands to enable the processor-based system to *decode the instruction* [of the VLIW] *to determine whether the instruction defines the single operation or the two independent operations based on the at least one identification bit that indicates the nature of the two independent operations when the instruction defines the two independent operations.*

The Examiner relied on elements 505 and 506 in Figure 25 of Yoshida to allegedly show the feature of claim 30 recited above. However, elements 505 and 506 correspond to separate instructions of a VLIW, and therefore do not indicate the nature of two independent operations when an instruction defines the two independent operations, as set forth in Appellant's claim 30.

Shiell, Yoshida, and Panesar, considered alone or in combination, do not teach each and every feature of Appellant's claim 30. Therefore, the Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 30. Accordingly, the rejection of claim 30 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 31 recites, among other features,

...commands to enable the processor-based system to *decode the instruction* [of the VLIW] *to determine whether the instruction defines the single operation or the two independent operations based on an $n/2$ th bit and an n th bit of the instruction having n bits.*

The Examiner relies on elements 505 and 506 in Figure 25 of Yoshida to allegedly teach the n th and $n/2$ th bits, respectively, of the instruction in Appellant's claim 31. However, element 505 corresponds to instruction 511 of the VLIW, and element 506 corresponds to instruction 512 of VLIW 501. Furthermore, elements 505 and 506 do not correspond to the n th and $n/2$ th bits, respectively, of an instruction (or even the VLIW 501).

Shiell, Yoshida, and Panesar, considered alone or in combination, do not teach or suggest commands to enable the processor-based system to decode the instruction [of the VLIW] to determine whether the instruction defines the single operation or the two independent operations based on an $n/2$ th bit and an n th bit of the instruction having n bits, as set forth in Appellant's claim 31.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 31 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 31. Accordingly, the rejection of claim 31 under 35 U.S.C. § 103(a) is improper and should be reversed.

Claim 33 recites, among other features,

...commands to enable the processor-based system to ***decode an instruction of the VLIW*** received during an instruction fetch ***to determine ... whether the instruction defines a single operation or two independent operations...***

In the Office Action, the Examiner merely stated that "claim 33 has nothing over claims 17-31 and is therefore rejected for the same reasons as set forth in claims 17-31." Thus, claim 33 is patentable over Shiell, Yoshida, and Panesar, considered alone or in combination, for at least the same reasons as those set forth above with respect to claims 17-31. Moreover, nothing in the combination of Shiell, Yoshida, and Panesar teaches or suggests commands to enable the processor-based system to decode an instruction of the VLIW received during an instruction fetch to determine ... whether the instruction defines a single operation or two independent operations, as set forth in Appellant's claim 33.

The Examiner has not met the burden required to maintain a *prima facie* case of obviousness with respect to claim 33 for at least the reason that the cited references do not teach each and every feature of Appellant's claim 33. Accordingly, the rejection of claim 33 under 35 U.S.C. § 103(a) is improper and should be reversed.

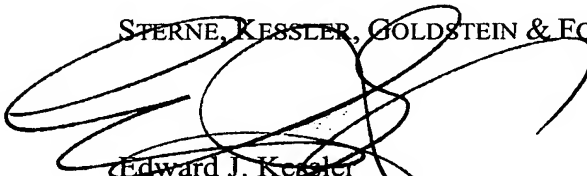
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VIII. Conclusion

The subject matter of claims 17-33 is patentable over the cited art because the Examiner has failed to show that each and every feature of the claimed embodiments is taught in the cited references. Therefore, Appellant respectfully requests that the Board reverse the Examiner's final rejection of these claims under 35 U.S.C. §§ 102(b) and 103(a) and remand this application for allowance and issue.

Respectfully submitted,

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Claims Appendix

17. A system to process very long instruction words (VLIWs), the system comprising:

a decode unit to decode an instruction of a VLIW received during an instruction fetch, wherein all instructions of the VLIW have the same predetermined instruction bit length; and

first and second processing channels, each processing channel including a plurality of functional units, at least one of the functional units of each processing channel being a data processing unit and at least one other of the functional units of each processing channel being a memory access unit;

wherein the decode unit is operable to determine whether the instruction defines a single operation or two independent operations and to control the first and second processing channels based on the determination.

18. The system according to claim 17, wherein, when the decode unit determines that the instruction defines two independent operations, the decode unit is operable to control the first channel to implement one of the two independent operations and the second channel to implement the other of the two independent operations, and wherein the first and second channels execute their respective independent operations simultaneously.

19. The system according to claim 17, wherein, when the decode unit determines that the instruction defines a single operation, the decode unit is operable to control the first and second processing channels to cooperate to execute the single operation.

20. The system according to claim 17, wherein the first and second processing channels share at least one common register file and are capable of simultaneously accessing the at least one common register file.

21. The system according to claim 17, wherein the decode unit is operable to determine whether the instruction defines a single operation or two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction.
22. The system according to claim 21, wherein the instruction has a length of n bits, and the at least one predetermined bit location includes the $n/2$ th bit and the n th bit.
23. The system according to claim 21, wherein the decode unit is operable to identify certain combinations of the two independent operations based on the at least one identification bit, and wherein a first combination denotes two data processing operations, a second combination denotes two memory access operations, a third combination denotes a data processing operation and a memory access operation, and a fourth combination denotes a long instruction.
24. A method of operating a system that processes very long instruction words (VLIWs), each instruction of a VLIW having the same predetermined instruction bit length, the method comprising:
 - decoding an instruction of the VLIW received during an instruction fetch to determine whether the instruction defines a single operation or two independent operations;
 - when the instruction defines two independent operations, supplying one of the independent operations to a first processing channel having a first plurality of functional units including a first data processing unit and a first memory access unit, and supplying the other of the independent operations to a second processing channel having a second plurality of functional units including a second data processing unit and a second memory access unit, wherein the two independent operations are executed simultaneously; and
 - when the instruction defines a single operation, controlling the first and second processing channels to cooperate to execute the single operation.
25. The method according to claim 24, wherein decoding the instruction includes determining whether the instruction defines the single operation or the two independent

operations based on at least one identification bit at at least one predetermined bit location in the instruction.

26. The method according to claim 25, wherein determining whether the instruction defines the single operation or the two independent operations includes determining whether the instruction defines the single operation or the two independent operations based on the at least one identification bit that indicates the nature of the two independent operations when the instruction defines the two independent operations.

27. The method according to claim 25, wherein determining whether the instruction defines the single operation or the two independent operations is based on an $n/2$ th bit and an n th bit of the instruction having n bits.

28. An article comprising a medium for storing commands to enable a processor-based system to:

process very long instruction word data including very long instruction words (VLIWs), each instruction of a VLIW having the same predetermined instruction bit length, wherein the commands to enable the processor-based system to process the very long instruction word data include commands to enable the processor-based system to decode an instruction of the VLIW received during an instruction fetch to determine whether the instruction defines a single operation or two independent operations;

when the instruction defines two independent operations, supply one of the independent operations to a first processing channel and supply the other of the independent operations to a second processing channel, wherein the two independent operations are executed simultaneously; and

when the instruction defines a single operation, control the first and second processing channels to cooperate to execute the single operation.

29. The article according to claim 28, wherein the commands to enable the processor-based system to decode the instruction include the commands to enable the processor-based

system to decode the instruction to determine whether the instruction defines the single operation or the two independent operations based on at least one identification bit at at least one predetermined bit location in the instruction.

30. The article according to claim 29, wherein the commands to enable the processor-based system to decode the instruction include the commands to enable the processor-based system to decode the instruction to determine whether the instruction defines the single operation or the two independent operations based on the at least one identification bit that indicates the nature of the two independent operations when the instruction defines the two independent operations.

31. The article according to claim 29, wherein the commands to enable the processor-based system to decode the instruction include the commands to enable the processor-based system to decode the instruction to determine whether the instruction defines the single operation or the two independent operations based on an $n/2$ th bit and an n th bit of the instruction having n bits.

32. A method of operating a system that processes very long instruction words (VLIWs), each instruction of a VLIW having the same predetermined instruction bit length and at least one identification bit at at least one predetermined bit location in the instruction, the method comprising:

fetching the VLIW from a program memory;

decoding each instruction of the VLIW, wherein decoding each instruction includes reading the identification bit of each instruction to determine:

- a) whether the instruction defines a single operation or two independent operations, and
- b) when the instruction defines two independent operations, the nature of each of the two independent operations selected at least from a data processing category of operation and a memory access category of operation.

33. An article comprising a medium for storing commands to enable a processor-based system to:

process very long instruction word data including very long instruction words (VLIWs), each instruction of a VLIW having the same predetermined instruction bit length and at least one identification bit at at least one predetermined bit location in the instruction, wherein the commands to enable the processor-based system to process the very long instruction word data include commands to enable the processor-based system to decode an instruction of the VLIW received during an instruction fetch to determine:

a) whether the instruction defines a single operation or two independent operations, and

b) when the instruction defines two independent operations, the nature of each of the two independent operations selected at least from a data processing category of operation and a memory access category of operation.

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Evidence Appendix

None

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Related Proceedings Appendix

None